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ABSTRACT

This study examined the effects of teacher aides on students' academic achievement, addressing: whether the presence of a full-time aide in K-3 classrooms would affect student achievement; whether the presence of an aide in the primary grades would affect students' later academic achievement (grades 4, 6, and 8); and whether the nature of aide duties would affect student achievement. Data came from Project STAR (Student Teacher Achievement Ratio), a longitudinal study of the effects of class size and teacher aides on student performance. Researchers collected achievement test scores for students in grades K-3, 4, 6, and 8 and time logs and questionnaires completed by teacher aides in grades 1-3. Results indicated that teacher aides had little if any positive effect on classroom achievement. There was some indication that the presence of an aide may positively affect students' reading achievement in the primary years, but only for students with extended participation in classrooms with aides. Results found that the extent to which aides performed various types of duties did not affect student achievement. The researchers conclude that teacher aides are not a suitable substitute for small classes in the early grades. (Contains 47 references.) (SM)

IT'S TIME TO DROP THE OTHER SHOE

(THE EVIDENCE ON TEACHER AIDES)

Paper at the Mid South Educational Research Ass'n (MSERA)

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It's Time To Drop The Other Shoe: The Evidence On Teacher Aides

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ABSTRACT

Teacher aides are common in education, especially in remedial and special-education classes, yet little is known about their effect on student outcomes. Project STAR is known for its class-size results, but few have inquired about the teacher-aide component in this large (11,601 students), randomized (teachers and students), longitudinal (grades K-3) education experiment.

In STAR, students were randomly assigned to one of three conditions within a school: Small (S) class (ave. 15), Regular (R) class (ave. 24) and Regular Class with full-time aide (RA). Teachers (n=1340) were randomly assigned to classes. Annually students took criterion-referenced tests (CRT) and norm-referenced tests (NRT). Results were compared using MANOVA (originally) and HLM (later). Other outcome measures (e.g., behavior, attendance) were also used. After students left the experiment (grade 4), they were followed through the grades. Available long-term data including achievement scores, high school records, grades, some behavior data, and ACT/SAT scores of students planning for college.

The purpose of this investigation was to examine the effects of teacher aides on students' academic achievement. Three primary questions were addressed: (1) Does the presence of a full-time teacher aide in K-3 classrooms affect students' achievement? (2) Does the presence of an aide in the primary grades affect students' later academic achievement (in Grades 4, 6, and 8)? (3) Does the nature of aides' duties (clerical, instructional, non-instructional) affect students' achievement? In investigating questions (1) and (2), we considered the duration of participation in a classroom with an aide (from 1 to 4 years).

Results suggest that teacher aides have little if any positive effect on classroom achievement. There is some indication that the presence of an aide may positively affect students' reading achievement in the primary years, but only for those pupils who have extended participation in an aide classroom. Most compelling is the finding that the extent to which aides performed various types duties had no effect on student achievement. The results are discussed in light of the increasing demands for paraprofessionals to play instructional roles in the classroom, and the need for policy and research to help address this call.

Conclusion. Teacher aides are NOT a suitable substitute for small classes in the early grades. The teacher aide issue needs serious attention if aides are to remain a key element of programs for minority and hard-to-teach students. Recommendations for improving the current situation will be forwarded.

Teacher Aides and Students' Academic Achievement

There are currently over 600,000 paraprofessionals[1] in classrooms throughout the country (Bureau of Labor Statistics [BLS], 1998b). Approximately 90% of paraprofessionals are employed in public schools, and about 75% are assigned to the elementary grades (U.S. Department of Education, 1997). The current level of employment represents an increase in over 200,000 positions in the past 10 years. The Bureau of Labor Statistics projects a faster than average increase in the number of teacher aide positions through 2006 (BLS, 1998a). The reason is due in part to anticipated increases in student enrollments, in part to the expansion of special education and Title-1 programs, and in part to the perceived success of aides in fostering prosocial behavior in children, in positively affecting student engagement and identification with school, in fostering parental involvement, in alleviating many teacher problems, and in affecting student achievement. Employing paraprofessionals has also been forwarded as a comparatively low-cost alternative to small classes[2] (e.g., Knox County Board of Education, 1991).

Many of these expectations are based on perceptions of benefits or "common sense" rather than empirical evidence. By and large, such empirical evidence does not exist. As many have noted, research addressing the effect of having teacher aides in the classroom, and work in establishing education and training programs for paraprofessionals are urgently needed (Hasselkorn & Fideler, 1996; LeTendre, 1999; Pickett, 1986, 1995; Salzberg & Morgan, 1995). Given the central role paraprofessionals play in many aspects of children's schooling, it is surprising that more research is not being conducted on the topic.

The present study examined the effects of teacher aides on students' academic achievement. First, we asked whether aides have any noteworthy impact on student achievement by comparing average achievement of students in classes with and without full-time teacher aides. Second, we examined just classrooms with teaching assistants, documenting the tasks they performed and asking whether different functions were accompanied by different effects on student achievement. The next sections of this paper summarize the history of the teacher aide profession to provide a context for understanding the current state of policy regarding aides, and previous research on the effects of teacher aides on students' academic performance.

Why are Teacher Aides So Prevalent?

In some form, teaching assistants have been utilized in the classroom since before the 1820s, but the first formal use of what have become today's paraprofessionals was in the 1950s (Brotherson & Johnson, 1971). Because of a substantial shortage of teachers in the country during the 1950s, attention turned to lessening the teachers' administrative burdens in order to allow them to devote more time to instruction; thus, the position of teacher aide was created (Pickett & NEA, 1994; U.S. Department of Education, 1998). Aides were viewed as the "third arm of the harried teacher" (Bennett & Falk, 1971, p. 32).

One of the first organized projects employing teacher aides was the 1953 Ford Foundation program in Bay City, Michigan, schools (Park, 1956). Eight classrooms in the school system were assigned teacher aides, who worked under the direction of the classroom teacher. Classroom observations of the experimental and control classrooms indicated that teachers with aides spent 89% less time correcting papers, 36% less time disciplining students, 25% less time on reports, and 83% less time monitoring students during work time. Teachers with assistants also more than doubled

the amount of time they spent on lesson plans, and devoted over 40% more time to supervising students. Parents with children in aide classrooms felt that their children enjoyed school more, and 83% reported that they learned more. The achievement advantage was only perceived, however; comparisons of test scores found no significant differences between groups. Despite the lack of quantifiable cognitive advantages, the Bay City Project sparked interest in teacher aides. The Ford Foundation funded several other projects in the ensuing years (Lombardo, 1980).

Beginning in the 1960s, several legislative acts helped to define the role of teaching assistants in the schools. Title I of PL 89-10, the Elementary and Secondary Education Act (ESEA) of 1965, designated $75 million for aides, to be employed specifically in low-income areas. The ESEA did not include guidelines regarding hiring practices or education/training requirements. The Nelson-Scheuer Amendment to the Economic Opportunity Act, however, provided $40 million in the 1966-67 year supporting new careers to assist the economically disadvantaged. The compatibility of the two acts was readily apparent. Most of the 30 cities receiving funding under ESEA used the monies to employ community members as teaching assistants. Thus, the prototype for the paraprofessional – an economically disadvantaged community member with little or no formal education or training in teaching and learning – was created. It remains largely intact today.

Aides' primary responsibilities during this period were still related to providing administrative assistance, although some educators started to discuss the possibility that aides could, under the direct supervision of the teacher, perform some instructional tasks as well. These tasks were related primarily to teaching reading, including simply reading to children or listening to them read aloud. A survey conducted by the National Education Association (NEA) in 1967 indicated that only 16% of teachers used their paraprofessionals for such reading activities. The majority of teachers, however, continued to assign aides to clerical tasks (Gilford, 1977). In fact, approximately 56% of teachers did so exclusively, indicating that they themselves wished to be responsible for all instructional tasks. This attitude was due in part to mistrust; although they welcomed the clerical assistance, many teachers were initially mistrustful of aides being too involved with the class, and preferred to minimize aides' interactions with pupils (Gilford, 1977; see also Rittenhouse, 1972).

Two additional legislative acts increased the demand for teaching assistants and expanded the scope of their duties. As a result of the Bilingual Education Act (1968), paraprofessionals who spoke two languages – again, usually community members – were hired to address the shortage of bilingual teachers. The 1975 Education for All Handicapped Act (PL 94-142) dramatically increased the call for aides as schools sought to meet the needs for individualized instruction for students with learning disabilities. Thus, teaching assistants began taking on more instructional duties in addition to clerical tasks (Bennet & Falk, 1971; Brotherson & Johnson, 1971; Lombardo, 1980; Pickett & NEA, 1994; Rittenhouse, 1972). This trend spilled over to all classrooms, including those serving non-special populations.

Educators of the 1970s, if not before, realized that aides would require special training for these responsibilities. Even the idea of providing special credentials was forwarded, and colleges and other agencies made concerted efforts to establish standards for career development of aides (Bennet & Falk, 1971; Brotherson & Johnson, 1971; Lombardo, 1980; Pickett & NEA, 1994, Rittenhouse, 1972). This enthusiasm subsided in the 1980s, and many of the guidelines that do exist today have not been updated for almost 30 years (Pickett & NEA, 1994).

Today the majority of parparofessionals are members of the community, many with children

attending the schools in which they are employed. In rural and urban areas, for instance, between 60% and 75% of paraprofessionals are minorities (U.S. Department of Education, 1998). Few have more than a high school education (Reynolds, 1995). The majority of teaching assistants receive only on-the-job training (Bureau of Labor Statistics, 1998b).

Nevertheless, aides are doing substantially more teaching than in the past. In fact, instructional duties and other student interactions may be starting to subjugate administrative tasks. In 1986, an observational study of aides in Indiana revealed that over 32% of a teacher aide's day was typically related to instruction (Barnes & Quimby, 1986). In 1997, a survey of paraprofessionals in Wisconsin revealed that the most often cited duty was instructional in nature – supervising one or more learners (Wisconsin Department of Education, 1998).

Chase & Mueller (1993) examined the types of instructional activities performed by aides. Of the time spent in teaching-related tasks, the largest proportion (over 54%) was devoted to helping individual students. Over 41% of aides' instructional time was devoted to small-group teaching; only 4% of the time did aides teach the entire class. Alarmingly, many paraprofessionals are teaching students without the benefit of guidance. Haselkorn & Fideler (1996) report that 20% of Title I aides throughout the country provide instruction without supervision of the teacher. With the increasing demand for aides, it seems likely that their responsibilities for providing direct instruction will only increase. It is imperative that we begin to explore the effects aides have on students and the relationship of these effects to their qualifications.

Teacher Aides and Student Achievement

Research on the effect of teacher aides on student achievement is not abundant, and many of the studies that have been conducted suffer from severe methodological problems. Our review of the literature unearthed only four studies of paraprofessional programs that were successful in limiting the number of confounding variables and methodological shortcomings. Unfortunately, the results of these studies provide neither consistent support for nor consistent repudiation of the use of aides in the classroom.

The Bay City, Michigan, Project involved students in kindergarten through Grade 7 (Park, 1956). Teaching assistants were community members, many of whom had at least some college education. All teacher aides were given training in the basic principles of child development and learning; they also received training in the operation of classroom equipment – ditto machines, film-strip projectors, and the like. By and large, they were not involved in much instructional interaction with students. Comparisons of scores on standardized tests between students in aide classrooms and those in similar control classrooms revealed no significant differences. Thus, the results of this study appear to indicate that teacher aides do not have indirect effects on student achievement by helping teachers with administrative or other non-instructional tasks.

The Minneapolis Teacher Aide program (Bennet & Falk, 1971) comprised an extensive and fairly well-controlled investigation conducted during the 1966-67 and 1967-68 school years. In addition to evaluating the impact of an aide in the classroom, researchers examined the effect of the number of aides: three classes had no aides, three were assigned one aide, and three were assigned five aides. Aides received one-half year of training in teaching reading readiness skills to kindergarten-age students. Teachers were given total freedom in utilizing their aides, but underwent short training sessions exploring potential uses. Students were administered the Metropolitan Readiness Test at the beginning and end of the school year.

Despite the training, almost all of the teachers used their aides in a similar manner – assigning them to "menial" tasks about 40% of the time, and having them "work with students" for the remainder of the time. Statistical comparisons indicated that having one or more aides in the classroom was beneficial to students' reading readiness. Although both boys and girls benefitted from being in a classroom with paraprofessionals, the advantage was more pronounced for boys. Interestingly, there was no additional benefit of having five assistants compared to one assistant in the classroom. The researchers speculated that this was due to the fact that with more aides, teachers spent more time training and coordinating their assistants' activities and less time involved in direct instruction.

Two separate studies evaluated a teacher aide intervention in Mississippi in the early 1980s (Davidson, Beckett, & Peddicord, 1994; Jackson, McHaney, & Handley, 1985). In September 1983, a statewide reform called for the addition of teacher aides to elementary-grade classes. The use of aides in the classroom was lauded as having far-reaching benefits, including providing students with the necessary foundation both to increase achievement during school and employment prospects after graduation (Davidson et al., 1994, p. 4). Students who began kindergarten in 1983 had a paraprofessional assigned to their classroom each year through Grade 3. Paraprofessionals were required to be high school graduates, although the reports do not reveal how much training (if any) they received.

Jackson et al. (1985) examined standardized test results in mathematics, reading, language, and spelling of two cohorts of African-American students in one school in Scooba, Mississippi. Achievement scores of students in Grade 1 in the 1982-83 school year (without aides) were compared to scores of students in Grade 1 in the 1983-84 school year (with aides). There were no significant achievement differences between cohorts. These two cohorts were also compared when in Grade 2. In the Grade-2 comparisons, students in classrooms with teaching assistants performed significantly better on some specific tests (mathematics concepts and applications, spelling, and language mechanics) but not on others (mathematics computation, reading comprehension, reading vocabulary, and language expression). Neither report documents the tasks that aides performed in the classroom. However, if the aides were used to provide students assistance with reading skills, these reported results would be perplexing.

Davidson et al. (1994) compared the 1982-83 and 1983-84 cohorts in Mississippi as well, but examined students in all schools in that state that participated in the reform. This investigation searched for possible long-term benefits of paraprofessionals in the primary grades by comparing student literacy achievement in Grades 5, 6, 8, and 11. In Grade 5 through Grade 8, there were no significant differences between students who had been in aide classrooms in Grades 1 through 3 and students who had not. In Grade 11, however, students who had been in classrooms with aides scored significantly *lower* than those with no aides in their classrooms. The authors stated that the "possibility that the exposure to teacher aides caused the score reduction could not be ruled out" (Davidson et al., 1994, p. 1).

Other research on paraprofessionals does not provide direct answers to the teacher-aide question. For instance, some designs involved differences other than the presence or absence of a teaching assistant in the classroom, making it impossible to tease apart the unique effect of aides (e.g., Holzmiller, Clark, & Powers, 1982; Rist, 1971). One study compared achievement between students taught by teachers and those taught by paraprofessionals (Manning, 1979). This comparison did not address usual classroom practice; more appropriate designs would compare similar

classrooms with and without teacher aides.

Perhaps the most troublesome aspect of this body of research is that few studies addressed the manner in which the aides are used in the classroom. It is thus difficult to determine whether the relationship (or lack of relationship) between aides and student achievement is due to the indirect effect of aides alleviating administrative burdens from teachers, the result of aides actually instructing students, or some combination of the two.

Focus of this Study

The present study examined data from Tennessee's Project STAR (Word et.al., 1990) to address a series of questions about teacher aides in the primary grades. Project STAR has received wide publicity for its findings about small classes. Except for one report published by Educational Research Service (Boyd-Zaharias & Pate-Bain, 1998) and one presentation by Achilles (1993), however, little attention has been given to the extensive data collected in STAR about teacher aides, their backgrounds, duties performed in the classroom, and effects on student outcomes. Our specific questions were:

(1) Is the presence of a full-time teacher aide in the classroom in Grades K-3 related to students' academic achievement?

(2) Do full-time paraprofessionals in K-3 affect academic achievement in later grades, e.g., Grades 4, 6, and 8?

(3) When teachers are free to deploy aides as they wish, what types of assignments and responsibilities are aides given?

(4) Does student achievement benefit more when teaching assistants perform certain functions more than others?

In addressing questions (1) and (2), we paid particular attention to duration; that is, the effect of spending fewer or more years in a teacher-aide class. Many early interventions are predicated on the expectation that benefits will be realized for years to come. Ramey & Ramey (1998) identified specific programmatic features that are essential in order for effects to endure. These include developmental timing (earlier start is better), duration (longer is better), and intensity (more direct instruction is better). Empirical evidence drawn from programs such as Head Start (Nielson, 1989), Follow-Through (Abelson, Zigler, & DeBlais, 1974), and the Chicago Parent Child Centers (CPC) (Reynolds, 1997) supports each of these principles. In Project STAR, the teacher-aide intervention, like the small-class intervention, began early (kindergarten) and continued for up to four years. However, aides did not consistently provide direct instruction to the students, leaving the question of short-term and long-term effects in need of an answer.

Methods

Participants

Subjects for the study were students, teachers, and teacher aides who participated in Tennessee's Project STAR (Student Teacher Achievement Ratio). Funded by the Tennessee State legislature, STAR was a large-scale, longitudinal experimental investigation of the effects of class size and teacher aides on academic performance. Students entering kindergarten in STAR schools in the fall of 1985 were randomly assigned to one of three experimental conditions – a small class (13-17 students), a regular class (22-26 students), or a regular class with a full-time teacher aide. Teachers and teacher aides were also assigned to the classes at random. STAR was a within-school design, which required at least one small class, one regular class, and one aide class in each school. In larger schools, there was more than one class of each type.

In most cases, students remained in the same class type through Grade 3, the duration of the experiment. Each year, a new grade-appropriate teacher and, in the aide classrooms, a new teaching assistant were assigned to the class. After STAR ended (Grade 4), all students returned to regular classes. The Tennessee Department of Education supported a continuing effort, the Lasting Benefits Study (LBS), to follow the progress of STAR students through the ensuing grades.

This investigation used data from STAR (kindergarten through Grade 3) and LBS (Grades 4, 6, and 8) to address previously unanswered questions about the effects of teacher aides. The complete K-3 STAR sample and the subset of students, classes, and schools used for the present analyses are summarized in Table 1. The full kindergarten sample included over 6300 pupils in 79 schools across the state. The number of students in the full sample increased slightly in Grade 1, when students entered who had not attended STAR kindergartens.[3]

Although pupils were assigned at random to the three class types, several factors caused the composition of the classes to become more complex in each successive grade. First, at the end of kindergarten, approximately one-half of regular-class students were assigned at random to teacher-aide classrooms and approximately one-half of the teacher-aide students were assigned at random to regular classes. No further purposeful reassignments were made after this point.

Second, migration of students into and out of STAR schools – a fact of life in both regular and experimental school programs – added to the complexity. Most Grade-1 students had attended kindergarten, but some had not. A small number of students, by changing schools, moved into a STAR classroom of a different type. The mixture of students in some classrooms became more complex in Grades 2 and 3, with some students having attended the same type of class for zero, one, or two previous years. In the present study, we exploited the information provided by the fact that students attended teacher-aide classes or small classes for different lengths of time. We focused on just those students with particular patterns of participation and used statistical controls to adjust for differential selectivity of students who were more mobile.

In the present investigation, students who were missing demographic information and/or missing test scores were eliminated from the analyses. Also, students who migrated from one class type to another were, under certain instances, eliminated. Specifically, students who attended both a small and an aide classroom at any time during the Project were eliminated from analyses beginning with the grade in which they changed class conditions. Students who moved from a small or an aide class into a regular class were also eliminated at the point of their move. The reduced sample (Table 1) had approximately the same composition as the full STAR sample; in each grade approximately one-third of the students were minority, of which 98.7% were African-American. Approximately one-half of the students received free or reduced price lunch.

Follow-up data were available for the students from Grade 4 onward; full and reduced sample sizes are given in Table 2. The full sample for Grade 4 was comparatively small because Tennessee altered its testing procedures in 1989-1990, and several large city districts declined to participate. As a result, there were fewer minority students and students receiving free or reduced-price lunches in the Grade-4 sample. Most or all districts participated in the testing program by the time the STAR students reached Grade 6, and the original percentages of minority students and students from lower SES families were restored.

For the investigation of enduring effects, only students who entered STAR classes in kindergarten or Grade 1 were considered. These students began early, as intended, and were able to participate for three or four full years. Students who entered STAR classes in Grade 2 or Grade

3 were a more diverse group and could not realize benefits of long-term participation. The reduced samples had similar proportions of minority students as the full sample, but somewhat fewer students receiving subsidized lunches.

Teaching assistants were hired by local school systems specifically for Project STAR using the same methods they had used in the past; approximately two-thirds indicated that they never saw a written job description. Most districts had no training procedures for aides, although several larger districts, accounting for approximately one-fourth of the teaching assistants, provided formal orientation programs.

All but one of the teaching assistants was female. Eighty-two percent were white; the remainder were African-American. Almost 90% of the STAR aides had attained a high school diploma. Three had not graduated from high school, and 17 had attained postsecondary degrees. Their educational attainments were similar to those of the majority of paraprofessionals in the country today (compared with the Bureau of Labor Statistics (1998)). The first year in which the aides participated in Project STAR, they had an average of 2.7 years of previous experience as teaching assistants. At the extremes, almost one-fourth had never worked as an aide before, and fewer than 12% had more than three years of experience.

Measures

Data for the present investigation comprised achievement test scores for the students in Grades K-3, 4, 6, and 8, and time logs and questionnaires completed by the teacher aides in Grades 1-3. Background information was available for each student including race/ethnicity, gender, and a measure of socioeconomic status (SES). For our analyses, students were classified as minority (African-American or Hispanic) or not minority (white or Asian); the SES measure was an indicator of whether the student participated in a free or reduced-price lunch program. Each student was also classified according to the number of consecutive years of participation in a particular class type: Grade 1 students could be in a particular class type for the first time (one year) or could have been in the same class type in kindergarten and Grade 1 (two years). Grade 2 students could have been in the particular class type for one, two, or three years; and Grade 3 students could have been in the same class type for one, two, three, or four consecutive years.

In spring of each school year, student achievement was assessed with a standardized achievement test battery. In kindergarten through Grade 3, students complete the mathematics, reading, and word study skills portions of the Stanford Achievement Tests (SATs; the Psychological Corporation, 1983). In Grades 4, 6, and 8, students completed the mathematics, reading, language, science, and social science portions of the Comprehensive Test of Basic Skills (CTBS; CTBS/McGraw Hill, 1989). For each battery, results were reported as scale scores derived through item response theory (IRT) to be comparable across grades.

In Grades 1 through 8, students were also administered reading and mathematics criterion-referenced tests, the Basic Skills First (BSF) examinations. These tests, developed by the Tennessee Department of Education, are tied closely to the sets of objectives set for Tennessee students. A student was considered to have mastered an objective if he or she completed 75% of the test items correctly. The present study employed the number of objectives mastered in reading and mathematics as additional achievement measures.[4]

Teacher Aide Information. In addition to race/ethnicity, gender, educational attainment, years of experience as an aide, and certification status, over 91% of the aides in Grades 1, 2, and 3 completed time logs (L) to record their duties. In the logs, the day was divided into 15-minute

intervals from 7:15 AM to 3:45 PM. For each interval, respondents were asked to indicate the activity in which they were engaged; the list included routine paperwork (e.g., grading, completing school administrative forms), planning and preparation (e.g., writing lesson plans, preparing bulletin boards, photocopying), routine student activity (e.g. bus duty, lunch duty), individualized instruction, small-group instruction, or whole-class instruction.

In Grades 2 and 3, the aides also completed a questionnaire (Q) that asked how much time they spent on each of 12 tasks: bus duty, recess, lunch duty, grading papers, taking attendance, preparing lessons, working with students with special needs, tutoring individual students, working with students in small groups, managing the class while the teacher is away, teaching the whole class, and giving or grading tests. Time was assessed in terms of minutes spent per day, minutes spent per week, and whether the task was performed less than once a week.

The duties assessed by the logs and questionnaires were grouped into the three categories listed in Table 3. Administrative duties primarily involved routine paperwork such as attendance and grading, and duplication of materials for students. Instructional tasks involved whole class, small group, and individual instruction. Non-instructional tasks involved interactions with the students but for non-academic matters, for example, monitoring the class of students during lunch or recess or helping students get ready for the bus, or providing materials needed for art work.

Methodological considerations dictated that we quantify aides' functions separately based on the logs and the questionnaires separately. For example, aides did not complete questionnaires in Grade 1; in Grades 2 and 3, some aides completed only one of instruments (or only one correctly). Also, the total amount of time aides recorded working differed as a result of the different time classifications of the instruments.

Preliminary data screening indicated that on the questionnaire, aides typically filled out the "minutes per day" column more completely and in a more consistent fashion than the other two columns. Thus, the per-day responses were used as the primary means of estimating time expenditure. If an aide completed only the weekly column, the time was divided by 5 to determine a daily total. If an aide completed only the column indicating that he or she engaged in a particular task less than once per week, he or she was given a total time of zero minutes per day for that task.[5] For the logs, the number of 15-minute intervals devoted to a particular task were totaled, and the sum was multiplied by 15. In Grade 3, aides completed two logs, one in the fall and one in the spring. For our analyses, the responses to the two were averaged.

For both the questionnaires and logs, the times spent on the three types of duties (administration, instructional, and non-instructional) were determined by summing the times for the individual tasks comprising the categories. The sums were converted to percentages of the total time recorded. The percentages were divided into thirds, and aides classified as "low," "medium," or "high" for each of the duties.

Analyses

Two types of analyses were performed. The first compared student achievement among the three class types with particular attention to the comparison of regular classes with and without teacher aides. Both immediate (K-3) and enduring (4, 6, 8) effects were examined, including a detailed analysis of duration in a classroom with a teaching assistant. The second set of analyses examined the duties aides performed in the classroom, and the relationship of these duties with student achievement.

All analyses were conducted through hierarchical linear modeling (HLM) procedures using

the HLM program (Bryk, Raudenbush, & Congdon, 1994). This procedure accurately computes regression estimates and standard errors for "nested" data such as those in Project STAR (students nested within classrooms; classrooms nested within schools). All tests of significance were conducted at the .01 level.

For the analysis of teacher-aide effects in Grades K-3, a three-level HLM model was used. In addition to test scores, the student-level variables included race/ethnicity, gender, SES, and the number of years students attended their particular class type (duration).[6] Classroom-level variables were two contrasts among class types: aide classes compared to regular classes and small classes compared to regular classes. At the school level, two contrasts of school location were tested: suburban schools compared to inner-city schools, and rural schools compared to inner-city schools.

In Grades 1-3, contrasts were tested that were not represented by the individual regression coefficients. Specifically, in Grade 1 we compared the performance of students who had been in an aide class for one year or two years, respectively, with the performance of students in regular classes. In Grade 2, we compared performances of students who had been in aide classes for one, two, and three years, respectively, to the performance of students who had been in regular classes. Four contrasts were required in Grade 3.[7] A parallel set of comparisons was tested for duration in a small class.

The full HLM model for Grades K-3 included the three-way interactions duration-by-class type-by-race/ethnicity and duration-by-class type-by-urbanicity, and the corresponding two-way interactions. When the three-way interactions were found not significant, they were eliminated from the model. Two-way interactions were then tested and, if not significant, were also eliminated.[8] Effect sizes were calculated for statistically significant effects by dividing the mean difference by the standard deviation of regular-class students.

For the analysis of long-term effects (Grades 4, 6, and 8), a two-level (students and schools) HLM regression model was employed. Students were classified by the STAR class type in which they participated, and duration was coded as the number of consecutive years in that condition.

In both sets of analyses, statistical controls were implemented to address the issue of student mobility. The duration variable, obtained for both regular and experimental students, provided some statistical control since students with shorter durations in STAR were likely to have moved from one school to another. Further, the analysis included three indicators linked closely with mobility: student race, student SES, and school urbanicity.

Comparisons Based on Aides' Duties. The analyses of teaching assistants' duties utilized only information from classrooms with teacher aides. A two-level (students and teacher aides) HLM model was employed. Student-level variables were achievement scores, race/ethnicity, gender, and SES. The teacher-aide variables were years of experience as a teaching assistant, educational attainment (advanced degree - high school graduate or less), and two contrasts of the extent to which each type of duty was performed. The "low" and "medium" categories of each type of task were compared to the "high" category, respectively.

This stage of the study required a number of separate analyses. Parallel runs were performed for each of the three types of tasks, with separate high-medium-low splits on each instrument (logs and questionnaires). Further, the regressions were computed for each of the five academic achievement measures. The results, however, were consistent across these instruments.

Results

Previous findings from Project STAR focused largely on the benefits of small classes: Finn

and Achilles (1990, 1999), and Word et al. (1990) reported that students in small classes outperformed those in full-size classes in all school subjects in all grades (K-3). The "small class advantages" (effect sizes) ranged from 0.15σ to 0.31σ. Although small classes impact academic achievement positively, they require extra space and fiscal resources not always available to school districts. If teacher aides can provide the same academic benefits, the savings might be considerable. Does the performance of students in classes with teaching assistants differ from that of students in classrooms without assistants?

Immediate effects of aides: Kindergarten through Grade 3. A summary of the regression results for the K-3 analysis is given in Table 4. The results for student and school background characteristics are consistent with prior research. With few exceptions, females outperformed males in both reading and mathematics in all four grades. The median gender differences in kindergarten through Grades 3 were 0.14σ, 0.14σ, 0.11σ, and 0.15σ, respectively. White students and students from higher SES backgrounds had an advantage over minority and lower-SES students, respectively, on virtually every test in every grade. The effects of SES were stronger than the effects of race/ethnicity, however. Median effect sizes for SES were 0.36σ, 0.42σ, 0.43σ, and 0.38σ in kindergarten through Grade 3, respectively. Median effect sizes for race/ethnicity were 0.23σ, 0.17σ, 0.18σ, and 0.21σ in kindergarten through Grade 3, respectively. The average performance of students in rural and suburban schools was greater than that of students attending inner-city schools on all tests in all grades.

The analysis confirmed previous reports that students in small classes outperformed students in full-size classes. The focus of the present study, however, was the impact of teacher aide classes. The comparisons of students in teacher-aide classes with students in regular classes are labeled "Aide-regular" in Table 4. For the total sample, no significant differences were found at $p < .01$ on any test in any grade. Students in aide classes in Grades K, 1, 2, and 3 were statistically indistinguishable from those in classes without aides.

Table 4 also summarizes specific duration contrasts for Grades 1 through 3. In Grade 1, students who were in aide classes for the first time were not significantly different from students in regular classes on any test; this is the contrast "1 year - regular" in the table. Students who had been in aide classes since kindergarten ("2 years - regular") scored significantly higher than their counterparts in full-size classes on all three verbal tests (SAT Reading, SAT Word Study Skills, and BSF Reading). The differences in average performance were approximately 0.22σ, 0.18σ, and 0.16σ on the three tests, respectively. No differences were found in mathematics performance.

In Grade 2, no statistically significant differences were found between students who were in an aide class for the first time and students who attended regular classes; in fact, most of the differences actually favored regular classes. No significant differences were found between students who had been in an aide class for two years (Grades 1 and 2) and students who were in regular classes. Students who had been in an aide class for three years, however, performed significantly better than did students in regular classes on two verbal tests (SAT Reading and SAT Word Study Skills) and marginally better on the SAT Mathematics scale ($p < .05$). The magnitude of the effects on the verbal tests were approximately 0.18σ and 0.21σ, respectively. No differences were significant on the BSF criterion-referenced tests.

All significant differences disappeared by Grade 3. No matter whether students had been in a teacher-aide class for one, two, three, or four years, their average performance did not differ from that of students who attended full-size classes without a teaching assistant. In fact, students who

had been in an aide class for just one or two years actually had poorer performance on each test, although these differences were not significant either.

The results of the K-3 analyses suggest that enduring participation in a class with a full-time teaching assistant may have some impact on pupils' reading scores – at least during the grades in which reading is emphasized. At the same time, these sporadic positive results arose in the context of many nonsignificant differences. For example, the reading advantage did not continue through Grade-3 regardless of how long students had attended a teacher aide class. No significant differences in mathematics performance were found in any grade. Finally, the analyses documented decrements in achievement in aide classes: although not statistically significant, Grade-2 students in the sample who had a teacher aide for one year and Grade-3 students who had an aide for two years, performed below students in regular classes in both reading and mathematics.

Enduring Effects: Grades 4, 6, and 8. Results of the analyses of enduring effects are summarized in Table 5. The effects of student characteristics on achievement in these grades were similar to those found in the K-3 analyses. Females had a fairly consistent advantage in reading, mathematics, and language achievement. The median effect sizes for these subjects in Grade 4, 6, and 8 were 0.13σ, 0.13σ, 0.11σ, respectively. Males outperformed females in science in Grade 4 (0.12σ), and more strongly in Grade 8 (0.20σ). Gender differences were not significant in social science until Grade 8 at which point females had an advantage over males (0.09σ). White students and those not receiving subsidized lunch scored consistently higher than minority and lower SES students, respectively, on every test in every grade. Median effect sizes for race/ethnicity were 0.25σ, 0.27σ, 0.28σ for Grades 4, 6, and 8, respectively. For SES, median effect sizes were 0.45σ, 0.47σ, and 0.45σ for Grades 4, 6, and 8, respectively. Students in both suburban and rural schools scored higher than those in inner city schools on all tests in all three grades.

Class-type comparisons revealed that the advantage of being in a small class compared to regular class endured strongly through Grade 4, to a lesser extent through Grade 6, and was not statistically significant in Grade 8. These comparisons include all students who attended small classes for one or more years. Other research has shown that three or more years of participation in a small class impact achievement through Grade 8 and perhaps beyond (Finn et al., 1999).

In contrast, there is very little evidence suggesting long-term benefits of attending a class with a teacher's aide. The overall comparison (labeled "Aide - regular" in Table 5) indicated that the only difference significant at $p < .01$ was in Grade 4 on the CTBS language test. Students from aide classes had an 0.18σ advantage in language achievement over students who had participated in regular-size classes without aides. No further overall differences were statistically significant in any grade.[10]

The contrasts involving duration of participation in an aide class failed to reveal a consistent pattern of enduring benefits. In Grade 4, several differences were significant at $p < .01$, but they were sporadic. One year of participation in an aide classroom was associated with superior performance on the CTBS language test (0.21σ) and the BSF reading test (0.18σ). There were no significant long-term effects associated with two years in a classroom with a teaching assistant. Students with three years in an aide class outperformed regular-class students only on the CTBS language test (0.18σ). Participation in an aide classroom for the longest period possible in STAR – four years – did not significantly affect any measure of student achievement.[11]

In Grade 6, students who had been in an aide classroom for one, two, three, or four years were statistically indistinguishable from students who had not participated in an aide classroom. No

differences were significant at the .01 level on any test. Likewise, Grade-8 students who had been in teacher aide classes, regardless of duration, were indistinguishable from those who attended classes without aides. In fact, 14 of the 28 contrasts favored non-aide classes, exactly the proportion expected when the difference is nil.

In sum, there were few if any enduring benefits to attending a class with a full-time teaching assistant. Further, increased particpation in an aide class was not consistently associated with increased achievement. If there were any carry-over benefits, they were realized by Grade-4 students in verbal areas, that is, language and reading. However, the significant results were not found consistently among students who spent fewer or more years with a teacher aide, and arose in the context of many nonsignificant differences. By Grade 6 (and by Grade 8), even the few possible benefits of teaching assistants had disappeared altogether.

Is there a relationship between the manner in which aides are deployed in the classroom and student achievement?

Characteristics of Aides' Duties. The duties aides performed during the school day were classified as administrative, instructional, or non-instructional (see Table 3). Table 6 summarizes the proportion of time aides reported that they spent on each type of task. Aides reported devoting the largest amount of their day – over 40% – to administrative tasks. Instructional tasks ranked second, comprising between 25% and 30% of the work day. The remaining 20% to 25% of time was devoted to non-instructional interactions with students. This distribution of duties is similar to that reported in other surveys, for example, Barnes and Quimby (1986).

The standard deviations in Table 6 indicate great diversity in individual aides' allocations of time. Despite the overall patterns, the logs indicated that approximately 30% of the aides in each grade spent more time on instructional tasks than on either administrative or non-instructional tasks. There was a slight tendency for aides to spend less time instructing students as grade levels increased (Table 6). If this is a reliable pattern, it may indicate that teachers are more reluctant to relinquish instructional duties as the material becomes more difficult. Correlations of aides' educational attainment with time devoted to the three types of tasks were uniformly weak; none was statistically significant. Likewise, correlations of aides' years of experience with time allocation were also uniformly non-significant. It does not appear that the teachers considered these factors in assigning responsibilities to their assistants.

Table 7 presents the relative amount of time spent on individual tasks within each of the categories. In terms of administrative tasks, teaching assistants spent more time doing paperwork than planning for class. Based on the questionnaires, for instance, planning accounted for less than one-fourth of the aides' time, whereas grading papers and administering tests occupied over two-thirds of their time. In terms of instruction, aides rarely taught the whole class; they spent most of their instructional time working with individual students. This is evidenced most dramatically in the questionnaires, where the proportions were 2% and 60% for whole class and individualized instruction, respectively. Finally, the majority (60%) of non-instructional interactions between aides and students occurred while the paraprofessionals were monitoring lunch.

Aides' Duties and Student Achievement. Prior to conducting the HLM analyses, we correlated the time aides spent on the types of tasks with students' verbal and mathematics achievement in Grades 1 though 3. Forty-two out of 50 correlations of instructional and non-instructional tasks with academic achievement were negative. Although none was statistically significant considered alone, the proportion of negative correlations (42/50 = 0.84) was significant

using a sign test at $p < .001$. Twenty-two out of 25 correlations of administrative tasks with academic achievement were positive. Again, none was statistically significant considered alone, but the proportion of positive correlations (22/25 = 0 .88) was statistically significant according to a sign test at $p < .0005$. These findings suggest first that more direct contact between teacher aides and students is associated with poorer student performance, and second that when teacher aides perform more clerical or administrative tasks, student achievement may be enhanced.

The HLM regression analyses examined the effect of time spent on tasks on academic achievement controlling for student and aide characteristics. Achievement differences for student characteristics (i.e., gender, race, SES) were not substantially different from those reported earlier in this paper; they are not repeated here. Student achievement was not significantly related to aides' educational attainment or years of experience in any grade.

In Grade 1, the extent to which aides performed each of the tasks was not related to any measure of achievement. This was found both in multivariate tests of the two "time" contrasts (low-medium, high-medium), and univariate tests of the individual contrasts. Similarly, in Grade 2, none of the multivariate or univariate comparisons was significant. In Grade 3, no comparisons were statistically significant at $p < .01$. Several tests of the effect of time spent in instruction approached significance ($p < .05$); the individual contrasts indicated that this is due to significant differences for the "high - medium" comparison. The means favored the medium group, however, suggesting that having aides spend a large amount of time directly instructing students may not be advantageous.

In sum, neither the experience level nor the educational attainment of the paraprofessionals was related to student academic achievement. More importantly, the manner in which teachers deployed aides was not related to test scores generally. The only exception was the suggestion that greater contact between aides and students had an adverse effect on performance, while students benefitted academically if aides performed more administrative tasks. When teacher are relieved of these routine clerical responsibilities, they may be able to spend more time instructing their students; this pattern was found in the Bay City, Michigan, project (Park, 1956). The preponderance of our results, based on 75 separate regression analyses, however, showed no noteworthy effects of the tasks performed by teacher aides on students' academic achievement.

Summary and Discussion

Over recent decades, the number of teaching assistants in American classrooms has grown steadily. During the same period, the disjunction between the demands made on paraprofessionals and their preparation and training to meet those demands has become increasingly wide. In particular, the need for teaching assistants to serve in an instructional capacity has increased to the point where it is often the primary function they perform. Yet even today, most teaching assistants have minimal educational attainments and little or no formal preparation for their work in the classroom.

The present investigation used data from a large-scale randomized experiment if the presence of a full-time teacher aide has a positive impact on students' academic achievement, and whether any academic benefits they may provide are related to their duties in the classroom. Our data were derived from comparable samples of teachers and aides in a number of schools and districts; our measures were well constructed; and our treatment of the data utilized sophisticated, appropriate analytic models. Academic achievement was examined during the years aides were present in the classroom (Grades K-3) and in the years afterwards (Grades 4, 6, and 8).

In terms of "overall" immediate effects, no differences were found between the average

performance of students in teacher aide classes and students in classes without aides on any test in any grade; this finding was consistent with that reported by Boyd-Zaharias and Pate-Bain (1998). The analysis indicated several possible conditions under which the presence of a teaching assistant may have a positive impact: students in Grade 1 who had teacher aides for two consecutive years and students in Grade 2 who had teacher aides for three consecutive years performed better than students in non-aide classes on several tests of reading. The advantage was not found for mathematics, however, and disappeared altogether by Grade 3.

The differences favoring classes with paraprofessionals were idiosyncratic given the host of nonsignificant and negative findings. They raise a question not examined in the present investigation, however: Who are the particular students who receive individual attention and/or assistance from teacher aides? If teaching assistants work closely with several students on reading skills, for example, this may be reflected in those students' scores but not impact the class as a whole. Our data did not include the information needed to address this question.

In terms of enduring effects of attending a class with a full-time teaching assistant, few if any benefits were found. The only suggestions of benefits occurred on Grade 4 reading and language tests, but were not found consistently for students who had spent fewer or more years in classrooms with an aide. By Grades 6 and 8, no difference in achievement significantly favored students who had attended aide classes, and several differences even favored pupils who had attended classes without teaching assistants; this results concurs with the findings of Davidson et al. (1994).

The analysis of tasks performed by teaching assistants was consistent with other surveys, with aides reporting that they spent about 40% of their time performing administrative tasks, about 25% to 30% of their time on instructional tasks, and about 20% to 25% of their time in non-instructional interactions with students. Approximately 30% of the aides reported that they performed more instructional tasks than tasks in either of the other classifications.

In our primary analyses we found no statistically significant relationships between the tasks aides performed and student achievement. Specifically, whether an aide assisted with instruction ("high" instructional tasks) or whether an aide performed many non-instructional activities had no discernable impact on the class's academic performance. It is possible that aides who perform clerical or routine work may enable teachers to spend more time in direct instruction. We found circumstances under which teaching assistants consistently impacted student performance, however.

What should be done?

From government statistics on the number of full-time and part-time teaching paraprofessionals in public and private schools in the United States, we estimate that the total salaries of teaching assistants in 1997 was approximately 8.4 billion dollars. With increasing numbers of assistants, the total is undoubtedly higher today and will continue to rise. If the primary function of paraprofessionals is to enhance pupils' academic achievement, this expenditure represents a significant misuse of resources.

We recommend that three courses of action be considered: (1) prescribe and monitor limited roles and responsibilities for teaching assistants, or (2) reallocate the funds spent on teaching assistants to programs that have documented effects on pupil performance, or (3) revise and upgrade the teaching-assistant role to one that itself has demonstrable benefits.

The first course of action is least consistent with the historical trend toward increasing aides' instructional responsibilities. Nevertheless, this study and others confirm that paraprofessionals, by and large, are not effective as teachers. Researchers can tell us if aides serve other valuable purposes

by addressing questions such as: Do paraprofessionals have a positive impact on the academic performance of particular pupils with whom they interact? Do aides have a positive impact on pupil behavior in the classroom or in school? Do teaching assistants decrease the burdens experienced by teachers, enabling them to be more efficacious in the classroom? The current state of research with respect to classroom paraprofessionals is woefully lacking. Systematic observational studies are needed in particular to understand the functions aides perform in the classroom and the consequences that ensue.

The second course of action may be the least plausible given political realities. Teacher-aide programs often employ people from the local community, providing additional income and a degree of fulfillment for a substantial number of parents. We note, however, that in this study and others, class size reduction has been shown to have a consistent positive impact on pupil achievement in all subjects – both in the short term and in later years (Finn & Achilles, 1999). The effects were particularly strong for minority students or students attending inner-city schools. According to a recent fiscal analysis (Brewer, Krop, Gill, & Reichardt, 1999), the estimated cost of teacher salaries to reduce class size to 15 pupils in Grades 1 through 3 throughout the U.S. is approximately $8.3 billion – very close to the total salary paid to aides in 1997.

The third course of action is difficult but may have the greatest payoff: Remedy the deficient preparation of paraprofessionals, the lack of clearly defined roles for aides in the classroom, and the absence of training for teachers in utilizing their assistants. That these functions are largely ignored today is all too apparent. Published materials for teacher aides are available but most are quite dated (e.g., Clough & Clough, 1978; Gattman & Hendricks, 1973; Howe, 1972; Lombardo, 1980; Welty & Welty, 1976). These guides, targeted toward the self-motivated teacher aide looking for guidance beyond that received on the job, provide information about the roles and responsibilities of paraprofessionals, school organization, and career options. Little information is provided about how to perform instructional or developmental activities. Teacher-education programs often lack any preparation for supervising or negotiating responsibilities with a teaching assistant. Popular educational psychology texts used in teacher-training courses do not even address the presence of an assistant in the classroom (e.g., Gage & Berliner, 1997; Gentile, 1997; Ormrod, 2000; Woolfolk, 1998). Recent concern with higher standards for teachers, by ignoring the poor preparation of paraprofessionals, may even exacerbate the problem.

Paraprofessionals in other fields (law or medicine, for example) undertake extensive training for their roles, have well defined responsibilities on the job, and clear career tracks with opportunities for advancement. Initiatives in this direction in education have been all too few. Only six states and the District of Columbia provide formal training plans for districts to help prepare teacher aides for their positions (Pickett & NEA, 1994). The U.S. Department of Education has identified ten teacher aide programs they term "effective." Six are affiliated with Title 1, serving students at risk, while four are district or state-based. Each program provides formal or structured workshops or on-the-job training opportunities for paraprofessionals in the areas of problem solving, small-group instruction, assessing and meeting instructional and emotional needs of learners, team building, and effective communication. However, none of these programs has been evaluated formally to determine the impact on student learning, student behavior, or teacher burden.

Policymakers should attend to these issues. If paraprofessionals are to make real contributions in the classroom, then the entire career line must be elevated. We agree with the U.S. Department of Education's (1998) list of requisites; we must:

(1) Define clearly the roles and responsibilities of teaching assistants, perhaps designating sub-classifications of paraprofessionals with different functions;
(2) Identify the necessary job qualifications and hire candidates by those standards;
(3) Develop an institutionalized program of continuing professional development and training, with formal ongoing evaluation;
(4) Provide organizational support for teaching assistants;
(5) Develop effective and attainable career ladders, perhaps leading from the role of teaching assistant to primary teacher.

Training for teachers and administrators to make best use of paraprofessionals' skills is an important corollary to recommendation (3). Particular consideration should be given to preparing aides to work with the increasing numbers of culturally diverse classrooms and students for whom English is a second language.

History explains clearly the dilemma faced by today's teaching assistants -- inadequate or nonexistent selection and training procedures but increasing expectations on the job. The situation cannot be allowed to continue, however. With strong programs in each of the areas listed above, paraprofessionals may attain the role envisaged by Skelton (1997) as assistant to the teacher as well as "paraeducator" integrally involved in pupil learning and development.

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Footnotes

[1]The term "paraprofessional" refers to an adult employed in the classroom to assist the teacher with instructional, administrative, and other tasks. There is no one label for such individuals; other terms currently in wide use are "teacher aides" and "teaching assistants." In this paper, we use these terms interchangeably.

[2] The average 1997 wage of paraprofessionals was $16,550. The average was for elementary school teachers was $37,310 (BLS, 1998b). Furthermore, unlike class-size reduction initiatives, employing teacher aides does not require finding additional classroom space.

[3]Although kindergarten was not mandatory in Tennessee in 1985, estimates indicate that almost 95% of the state's children did attend kindergarten.

[4]The number of objectives for reading and mathematics, respectively, were: Grade 1 – 8 and 11; Grade 2 – 12 and 15; Grade 3 – 10 and 15; Grade 4 – 7 and 8; Grade 6 – 7 and 9; Grade 8 – 7 and 10.

[5]This procedure resulted in one individual in Grade 3 indicating that she had spent no time performing any of the tasks. This was considered to be unrepresentative of her daily work, and she was eliminated from further analyses using the questionnaire information.

[6]Duration was included in the model as a control variable, and to allow us to test specific interactions with duration.

[7]All contrasts were obtained by evaluating algebraically the "expected values" of the final models for particular values of the independent variables (e.g., one year of aide classes; two years of aide classes; regular classes) and subtracting (see Bryk & Raudenbush, 1992). This process yields a set of coefficients that multiply the regression weights to estimate each contrast of interest. The coefficients can be entered back into the HLM program – the easiest way to compute estimates and tests of the desired contrasts.

[8]The duration-by-class type interaction was never eliminated from the model; it was necessary in order to calculate the duration contrasts from the regression results.

[9]In Grade 1, the p-values for two tests (SAT Reading and SAT Word Study Skills) were less than .05; in each instance, the difference favored teacher aide classes.

[10]Several differences were marginally significant ($p < .05$) in favor of teacher-aide classes; specifically, both mathematics tests in Grade 4 and the BSF reading test in Grade 6.

[11]Again, several effects were marginally significant ($p < .05$) in Grade 4.

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Table 1
Description of K-3 STAR Sample

	Kindergarten		Grade 1		Grade 2		Grade 3	
	Full Sample	Reduced Sample	Full Sample	Reduced Sample	Full Sample	Reduced Sample	Full Sample	Reduced Sample
Number of schools	79	79	76	75	75	72	75	73
Number of classes	325	325	339	332	340	324	340	321
Number of full-time teacher aides	99	99	100	98	107	98	108	106
Number of students	6325	5742	6829	5425	6840	5384	6802	5229
Percent minority	32.7%	32.4%	33.1%	34.2%	35.0%	34.9%	33.5%	32.1%
Percent receiving free/reduced price lunch	48.4%	48.3%	51.6%	50.2%	48.8%	48.7%	50.5%	47.3%

Note. N's are based on the analyses using SAT tests; due to missing data, N's differ slightly for analyses employing BSF tests.

Table 2
Description of Grade 4, 6, and 8 Samples

	Grade 4		Grade 6		Grade 8	
	Full Sample	Reduced Sample	Full Sample	Reduced Sample	Full Sample	Reduced Sample
Number of schools	62	61	525	464	502	405
Number of students	4347	2833	6011	4306	6015	4164
Percent minority	19.9%	16.4%	32.8%	27.8%	33.1%	32.5%
Percent receiving free/reduced price lunch	39.3%	34.4%	47.1%	41.9%	47.0%	41.8%

Table 3
Individual Tasks Comprising Aide Duties

Administrative	Instructional	Non-instructional
Paperwork (L,Q)	Tutoring individuals (L,Q)	Bus duty (L)
Grading (Q)	Leading small groups (L,Q)	Monitoring lunch (L)
Planning (L,Q)	Teaching whole class (L,Q)	Monitoring recess (L)
Taking attendance (Q)	Instructing those with special needs (Q)	Managing class in the absence of the teacher (L)
Administering tests (Q)		Routine student activity (Q)
Preparing bulletin boards (Q)		Assisting with artwork (L)
Hanging art in the hall (Q)		

Note. L indicates item is on time logs; Q indicates item is on questionnaires.

Table 4
HLM Regression Coefficients for K-3 Analyses

	Stanford Achievement Tests (SAT)			Basic Skills First (BSF)	
Effect	Reading	Mathematics	Word Study Skills	Reading	Mathematics
Kindergarten					
Male	-4.94***	-5.89***	-5.03***		
Non minority	7.15***	17.16***	6.68***		
Nonfree lunch	14.71***	19.84***	15.85***		
Suburban - inner city	13.49**	20.62**	16.87***	NA	
Rural - inner city	10.54**	17.73**	11.72***		
Class type					
Small - regular	6.40***	9.07***	7.24***		
Aide - regular	1.11	0.24	1.32		
Grade 1					
Male	-10.10***	-0.21	-7.93***	-0.35***	-0.04
Non minority	7.37***	16.79***	5.36*	0.33***	0.64***
Nonfree lunch	26.90***	17.63***	24.46***	0.69***	0.62***
Duration	9.35***	4.84***	7.56***	0.27***	0.13*
Suburban - inner city	36.19***	22.52***	30.01***	0.75***	0.87***
Rural - inner city	41.86***	29.03***	30.74***	0.72***	0.95***
Class type					
Small - regular	15.99***	13.04***	15.83***	0.61***	0.47***
Aide - regular	5.59*	2.16	5.52*	0.19	0.13
1 year - regular	-1.98	-1.47	0.14	0.02	0.03
2 years - regular	11.52***	5.00	9.74***	0.32**	0.21

(Table Continues)

Suburban - inner city	17.15***	12.66***	13.31***	28.50***	12.68***	1.16***	0.70*
Rural - inner city	17.03***	13.71***	10.64***	28.50***	12.07***	1.30***	0.90**
Small - regular	3.81*	4.09*	4.22*	0.93	4.80**	0.82**	0.44
Aide - regular	-0.92	2.08	2.28	-3.47	1.34	0.64*	0.28
1 year - regular	-0.61	2.59	2.22	-3.11	1.71	0.79*	0.34
2 years - regular	-0.82	2.18	2.34	-3.41	1.48	0.65*	0.28
3 years - regular	-1.03	1.76	2.45	-3.70	1.25	0.51	0.23
4 years - regular	-1.24	1.34	2.57	-4.00	1.02	0.37	0.17
Grade 8							
Male	-4.66***	-5.52***	-19.44***	8.87***	-3.85**	-0.65***	-0.21*
Non minority	15.45***	11.16***	7.66**	15.38***	12.85***	0.95***	0.79***
Nonfree lunch	20.11***	22.44***	21.51***	16.80***	18.86***	1.14***	1.24***
Duration	0.64	0.90	0.72	-0.09	0.60	0.02	0.02
Suburban - inner city	4.31**	4.08*	5.00**	3.94*	4.68**	1.33***	1.45***
Rural - inner city	-0.78	-0.06	1.34	-0.34	-0.13	1.45***	1.72***
Small - regular	1.75	3.04	2.72	1.86	2.72	0.17	0.12
Aide - regular	-0.42	0.67	1.79	0.30	-0.37	-0.02	-0.03
1 year - regular	0.86	1.16	2.00	1.99	0.70	0.07	0.07
2 years - regular	-0.17	0.83	1.93	0.56	-0.14	-0.01	-0.01
3 years - regular	-1.21	0.50	1.86	-0.87	-0.99	-0.08	-0.09
4 years - regular	-2.24	0.17	1.79	-2.29	-1.83	-0.15	-0.17

Note. Duration-by-small and duration-by-aide interactions are also included in the estimation model; they are necessary to estimate specific duration contrasts.
* $P < .05$, ** $P < .01$, ***$P < .001$.

Table 6
Mean Percentages of Time Devoted to Categories of Tasks

	Logs			Questionnaires	
	Grade 1	Grade 2	Grade 3	Grade 2	Grade 3
Administrative	41.4% (18.5%)	44.5% (18.6%)	46.7% (16.4%)	52.3% (14.8%)	53.9% (16.9%)
Instructional	32.5% (15.9%)	31.3% (18.0%)	29.7% (15.8%)	29.3% (15.4%)	26.3% (19.2%)
Non-Instructional	26.1% (13.0%)	24.1% (12.0%)	23.7% (8.3%)	18.4% (9.8%)	19.8% (13.4%)

Note. Standard deviations in parentheses; columns sum to 100%.

Grade 2					
Male	-8.37***	-0.19	-5.45***	-0.56***	-0.28***
Non minority	8.18***	13.80***	6.14*	0.53***	0.44***
Nonfree lunch	21.43***	18.64***	22.73***	1.03***	0.79***
Duration	5.16***	2.42**	6.69***	0.25***	0.08
Suburban - inner city	28.52***	18.81***	28.35***	1.46***	0.58*
Rural - inner city	36.66***	30.89***	33.56***	1.71***	1.02***
Class type					
Small - regular	11.51***	10.92***	12.54***	0.61***	0.45***
Aide - regular	3.48	2.18	3.69	0.10	0.14
1 year - regular	-2.66	-2.15	-4.97	-0.14	0.00
2 years - regular	2.84	1.73	2.78	0.07	0.12
3 years - regular	8.33**	5.62*	10.53***	0.28	0.24
Grade 3					
Male	-7.79***	-0.80	-8.14***	-0.54***	-0.24***
Non minority	8.02***	8.79***	6.07**	0.36***	0.62***
Nonfree lunch	15.60***	14.88***	15.35***	0.90***	1.09***
Duration	2.98***	2.50***	3.38***	0.12***	0.14***
Suburban - inner city	19.95***	17.21***	23.88***	0.80***	1.20***
Rural - inner city	24.70***	22.95***	28.53***	1.12***	1.80***
Class type					
Small - regular	8.15***	6.02**	9.17***	0.33**	0.36*
Aide - regular	0.73	-0.70	1.00	-0.01	-0.11
1 year - regular	-4.63	-3.37	-3.84	-0.15	-0.24
2 years - regular	-1.39	-1.77	-0.92	-0.07	-0.16
3 years - regular	1.84	-0.16	1.99	0.01	-0.09
4 years - regular	5.08*	1.44	4.90	0.09	-0.02

Note. Duration-by-small and duration-by-aide interactions are also included in the estimation model; they are necessary to estimate specific duration contrasts.
* $P < .05$, ** $P < .01$, *** $P < .001$.

Table 5
HLM Regression Coefficients for Grade 4, 6 and 8 Analyses

	Comprehensive Test of Basic Skills (CTBS)					Basic Skills First (BSF)	
Effect	Reading	Mathematics	Language	Science	Social Science	Reading	Mathematics
Grade 4							
Male	-6.57***	-8.27***	-16.37***	6.25***	-0.75	-0.61***	-0.18*
Non minority	15.41***	8.95**	7.71*	13.54***	10.23*	0.83***	0.86***
Nonfree lunch	22.71***	20.57***	20.14***	20.90***	26.53***	1.15***	1.09***
Duration	2.41*	2.25*	2.79**	3.16***	3.44**	0.12*	0.15**
Suburban - inner city	31.63***	17.16	26.48***	35.17***	29.70**	1.55***	1.38**
Rural - inner city	32.16***	23.82**	25.70***	38.40***	32.62***	1.55***	1.57***
Small - regular	10.15***	12.43***	11.25***	9.58***	12.91***	0.53***	0.51***
Aide - regular	3.17	6.71*	7.82**	4.67	6.11	0.21	0.29*
1 year - regular	5.37	7.14*	9.23**	4.02	6.19	0.43**	0.32
2 years - regular	4.38	6.98	8.62*	4.38	6.22	0.33*	0.31*
3 years - regular	3.60	7.03*	8.25**	5.04	6.56	0.23	0.31*
4 years - regular	2.40	6.67*	7.39*	5.12	6.28	0.12	0.28
Grade 6							
Male	1.25	-5.68***	-14.90***	1.66	0.16	-0.50***	-0.18
Non minority	13.36***	9.08***	8.38***	21.13***	6.71**	0.74***	0.67**
Nonfree lunch	19.63***	21.53***	20.99***	22.05***	20.01***	1.12***	0.66**
Duration	0.74	0.36	0.36	0.17	1.34	0.12	1.11***

(Table Continues)

Table 7
Mean Percentages of Time Devoted to Specific Tasks Within Categories

	Logs			Questionnaires	
	Grade 1	Grade 2	Grade 3	Grade 2	Grade 3
Administrative					
Paperwork	56%	59%	62%		
Planning	44%	41%	38%	23%	23%
Grading				56%	56%
Attendance				9%	9%
Giving tests				13%	9%
Preparing bulletin boards				NA	1%
Hanging art in the hall				NA	2%
Instructional					
Whole class instruction	15%	13%	19%	2%	2%
Small group instruction	34%	33%	32%	36%	29%
Tutor individual students	51%	54%	50%	38%	42%
Work with special needs students				24%	22%
Teach students to use computers				NA	5%
Non Instructional					
Student activity	100%	100%	100%		
Bus duty				8%	6%
Recess				18%	9%
Lunch duty				63%	66%
Manage the class				12%	14%
Assist students with artwork				NA	5%

Note. Blanks left for tasks not listed on the specific measure; NA indicates for items not listed on the instrument for that grade.

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